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GEOLOGICAL CHARACTERISTICS OF THE REGION GEREDE (BOLU)

ABSTRACT

The study area covers an area of approximately 600km^2 in the Gerede district of the Province of Bolu, which is located in 1/25.000 scale G28 a1 a2 a3 a4 topographical sheets showing north-west of Turkey. This study tried to reveal the general geology of the study region, which is bound by the Mengen district on the north and Gerede district on the southeast. The study area includes various rocks with similar lithology and stratigraphic sequence with ages ranging from the Paleozoic to Quaternary period. Although the base complex, which constitutes the oldest, rocks of the region, cannot be observed in the mapped geographical area in Gerede, though it's known to exist at the base. The limestones developed on the tithonic facies of Late Jurassic-Early Cretaceous age on the base complex of Permo-Triassic period are incompatible. It is determined that the Upper Jurassic-Lower Cretaceous aged limestones are rich in titonic facies and rich in calpionel contents. As a result of detailed paleontological and biostratigraphic studies on the samples; 3 calpionel species and 7 species of these species, including Tintinnopsella carpathica (Murgeanui & Filipescu), Crassicollaria brevis Remane, Crassicollaria intermedia (Durand Delga), Crassicollaria parvula Remane, Crassicollaria massutiniana (Colom), Calpionella alpina Lorenz, Calpionella elliptica Cadisch. It was determined in the study area, the lower levels of Upper Cretaceous are composed of sandstone-shale-marl intercalated flysch and clayey limestones containing agglomerate intercalations and the Maastrichtian level are composed of rocks and felsic intrusive rocks in the volcano-flysch facies. Among Maestrichtian age-giving units; Globotruncana arca Cushman, Globotruncanita conica White, Rosita contusa (Cushman) and Globotruncana sp. planktonic foraminifera were detected. Considering the relationship between the rocks in the region, the presence of a gradual transgression along the Mesozoic is noteworthy. It is composed of Tertiary, Paleocene aged sandstone shales, agglomerate, Lutetian, Miocene and Neogene aged terrestrial formations with volcanic activities, occurred in a marine environment and particularly observed in the western part.

Keywords: Gerede, General Geology, Stratigraphy, Paleozoyik, Bolu

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1. INTRODUCTION

So far, many studies have been carried out in the area and in its vicinity, including petroleum geology, tectonics, sedimentology and stratigraphy. Some of these studies are [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19]. The general geological features of the region were first presented by [3], and the stratigraphic states of the rocks formed in various facies were given. Because different preformations were used for these units in previous studies, formation name was not used in order to avoid confusion in the geological literature. In this study, geologic, chronostratigraphic and paleontological properties of the units in the region were investigated in detail and the results obtained were compared with those of similar studies in the region near the region. Taking into consideration the geological studies mentioned above, it is the main aim of this article to re-examine the stratigraphic characteristics of the rock units that have been exposed in Gerede (Bolu) and its immediate vicinity.

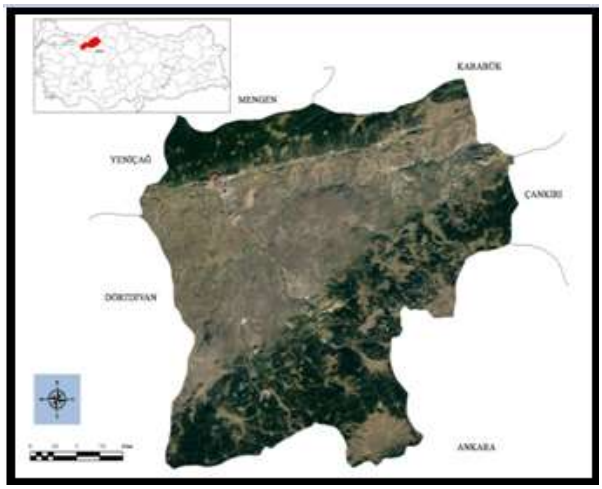

Figure 1. Location map of the study area

2. RESEARCH SIGNIFICANCE

Within the context of the scientific research study about the geology and stratigraphy of the units surfacing on Gerede(Bolu) region in the Pontid zone, the basement rocks in the region and the stratigraphy of the nappe units composed of maximum nautical sediments covering these rocks in a significant unconformity are aimed to be evained in detail. In this study, geologic, chronostratigraphic and paleontological properties of the units in the region were investigated in detail and the results obtained were compared with those of similar studies in the region near the region. Taking into consideration the geological studies mentioned above, it is the main aim of this article to re-examine the stratigraphic characteristics of the rock units that have been exposed in Gerede (Bolu) and its immediate vicinity.

3. GENERAL GEOLOGY OF GEREDE (BOLU) REGION

It is known that in the study area covering the Gerede (Bolu) region, although it cannot be observed in the geographical area mapped, the Basic complex, which constitutes the oldest rocks of the region, is available. The Upper Jura-Lower Cretaceous limestones of the Upper Permo-Triassic age are unconformably overlain by the Titonik facies. In the study area, the lower levels of Upper Cretaceous are

composed of sandstone-shale-marl intercalated flysch and clayey limestones containing agglomerate intercalations and Maastrichtian rocks and felsic intrusive rocks in the volcano-flysch facies. The presence of a gradual transgression along the Mesozoic is noteworthy, given the association of the rocks in the region with one another. Tertiary, Paleocene aged sandstone consists of Lutetian, Miocene and Neogene aged terrestrial formations where volcanic activity was observed in the shale, aglomeralar, marine environment and more intense in the western part (Figure 2).

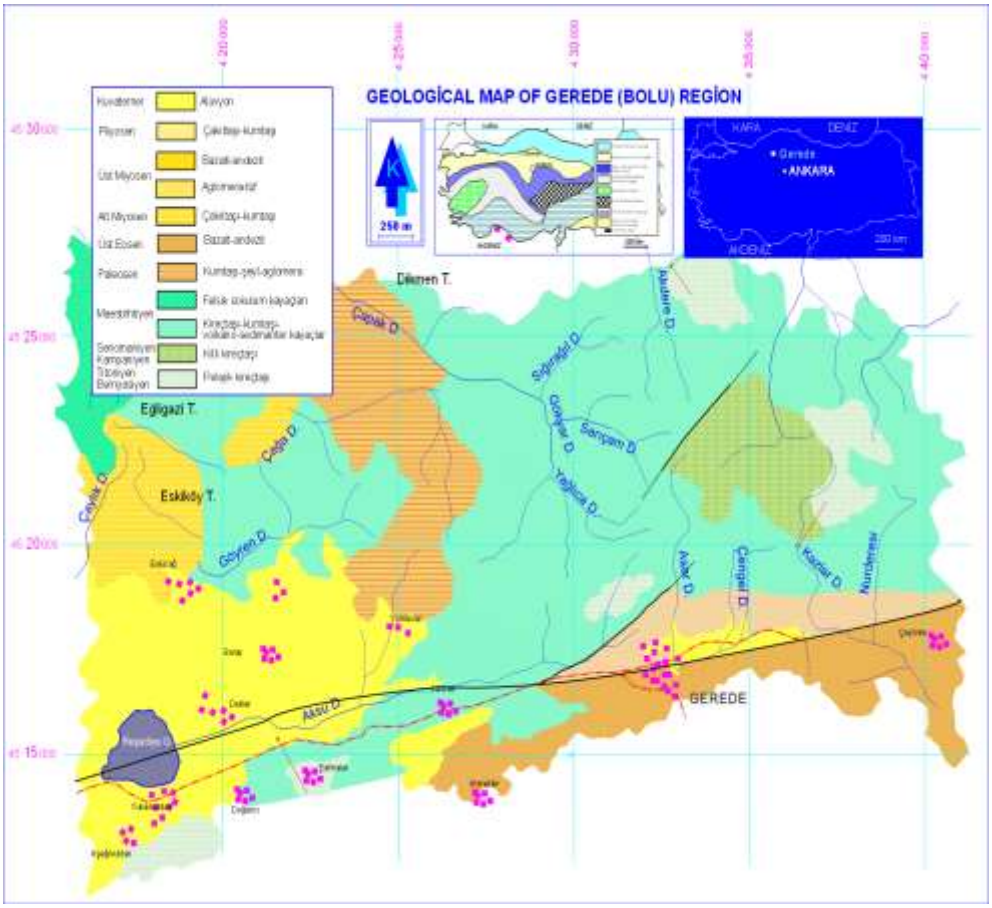

Figure 2. The geological map of Gerede (Bolu) region

4. STATIGRAPHY OF GEREDE (BOLU) REGION

- **Jura-Lower Cretaceous:** It forms the oldest of the units that are exposed in the study area. The Titonian-Hotrivian units starting with fossiliferous biomicritic limestones at the bottom, continuing with Titonik facies-advanced calpionellibiomicritic limestones, and Barremian-Campanian with upwardly pelagic limestones and Maastrichtian units at the top with shallow marine facies, and end with radiolarial-fossiliferous biomicritic limestones (Figure 3).
- **Titoniyen-Lower Berriyasiyen:** The unit, which gives small facies around the northern and northeastern parts of the Gerede site in the study area and the Reşadiye Lake in the southwest, is beginning with the level of gray-dark gray, calcite veined, fossiliferous biomicritic clay-less sandy limestones at the base and gray, thin layered calpionellibiomicritmicrobiophilic claylimestones. Cadosina lapidosa Vogler, Praetintinnopsella

andrusovi Borza, Pseudotextularia sp., Mesoendothyra sp., Radiolaria and sponge spikes and pelagic ammonitic crust fractures were identified in the gray-dark gray colored fossiliferous biomicritic limestones. Within the levels of abundant calpionellibiomicritic thin bedded limestone of the unit developed with Titonic Facies; Upper Titonian-Lower Berriyasian age; There were abundant Radiolaria and sponge spicules as well as Tintinnopsella carpathica (Murgeanui & Filipescu), Crassicollaria brevis Remane, Crassicollaria intermedia (Durand Delga), Crassicollaria parvula Remane, Crassicollaria massutiniana (Colom), Calpionella alpina Lorenz, Calpionella elliptica Cadisch,calpionel. Crassicollaria intermedia, Calpionella alpina, and Calpionella elliptica calpionel biozones have been identified in studies on calpionel biostratigraphy, which is one of the calpionelles, which is characterized by the presence of calpionel and developed in these levels of titonic facies.This unit, measured 227 m thick in the study area, is incompatible with the older Cenomanian-Campanian units.

- **Senomaniyen-Kampaniyen:** The unit, which is located immediately north of the Gerede District in the study area and in the Karanlıkdere region in the northwest, is composed of clayey limestones in the microbiophysiology of globotruncanizedbiomicrites of gray, somewhat variegated color. Greenish colored dacitic-andesitic tuff interbeds were observed in the upper levels of the unit. Bronze-bearing marls and abundant fossiliferous clayey limestones contain Cenomanian-Campanian age; Helvetoglobotruncana helvetica (Bolli), Praeoglobotruncana gibba Klaus, Dicarinella imbricata (Mor nod), Whiteinella sp. and Miliolidae fossils were found in the uppermost levels of the unit, Globotruncaca bulloides Vogler, Globotruncana elevata (Brotzen), Globotruncana lapparenti Brotzen and Globotruncana sp. planktonic foraminifera were detected (Figure 3). The limestones that make up the unit are products of a calm and deep sea. The andesitic tuffs intercalated with the limestones at the upper levels indicate that the region sometimes acquires volcanic activity.
- **Maestrihtiyen:** Maestrichtian aged units in the study area developed in volcano-flysch facies and are composed of yellowish-gray limestone-sandstone-marl alternation. In the upper levels, the sandstones are repressed and observed as sandstone-marl alternation. The sedimentation of the YumacuğunDere region in the north-western part of the Gerede District reveals that sedimentary basalt, andesite, andesitic basalts, tuffs and aglomerals play an active role during the sedimentation. Maestrichtian age in the samples taken from the limestone and marly sections of the limestone-sandstone-marl alternation phyllitic level, which gives rise to an area in the north-east of the town of Gerede; Globotruncana arca Cushman, Globotruncanita conica White, Rosita contusa (Cushman) and Globotruncana sp. planktonic foraminifera were detected (Figure 3). Boulder rocks have been deposited in a very active sea. The widespread submarine volcano has increased this movement even further.
- **Paleocene:** The unit, which confronts the Tinaztepe region on the northern side of the Gerede District of the investigated area, is composed of sandstones and sandstone-shale alternation with agglomeratic levels. In the region, sedimentary basalt, basalt,

andesite, andesitic basalts and tuffs also surface. During the sedimentation, the presence of submarine volcanism is observed, although it is not very effective.

- **Upper Eocene:** The area of Gerede which is located in the investigated area gives a wide area in parallel to the south of the fault passing through the north-southwest direction from the immediate north of the county. In the units composed of granite, gneiss, basalt and agglomeratic levels, bluish colored marls and tuffs forming a separate level are observed. The age of the unit was considered as the Upper Eocene by considering the stratigraphic position and comparing it with the works performed in the nearby regions (Figure 3).
- **Lower Miocene:** The terrestrial formations consisting of dark colored conglomerates and sandstones overlain by the Upper Eocene aged volcanic units have been overlain by the terrestrial and predominantly volcanic units since the Miocene. Despite the fact that the fossil is not found in the lithologic unit which is gradually becoming shallow, it is thought that the unit is of Lower Miocene age due to its stratigraphic position. In the area of examination of the unit, the small areas around the EskiköyTepe in the western part of the Gerede District are confronted.
- **Upper Miocene:** Since the Upper Miocene, volcanic activity has increased and andesites and basaltic lava flows have been observed. Because these volcanics are overlain by conglomerates and sandstones which are considered to be Lower Miocene ages, it is thought that the unit is of Upper Miocene age because of its stratigraphic position and regional correlation. In the unit survey area, a large area in the south of the Gerede District gives rise to the east-west trend (Figure 3).
- **Pliocene:** Located in the middle of the study area, the western part of the Gerede District consists of loose, undeclared conglomerates and sandstones composed of older rocks and without diagenesis. The components of this unit, which sedimented in a completely shallow sedimentation basin, are mostly derived from rocks in the immediate vicinity.
- **Alluvium:** Alluviums are found in the Aksu Stream valley flowing in the eastern-western direction in the central part of the study area and on the roads connected to this stream from the north and south.

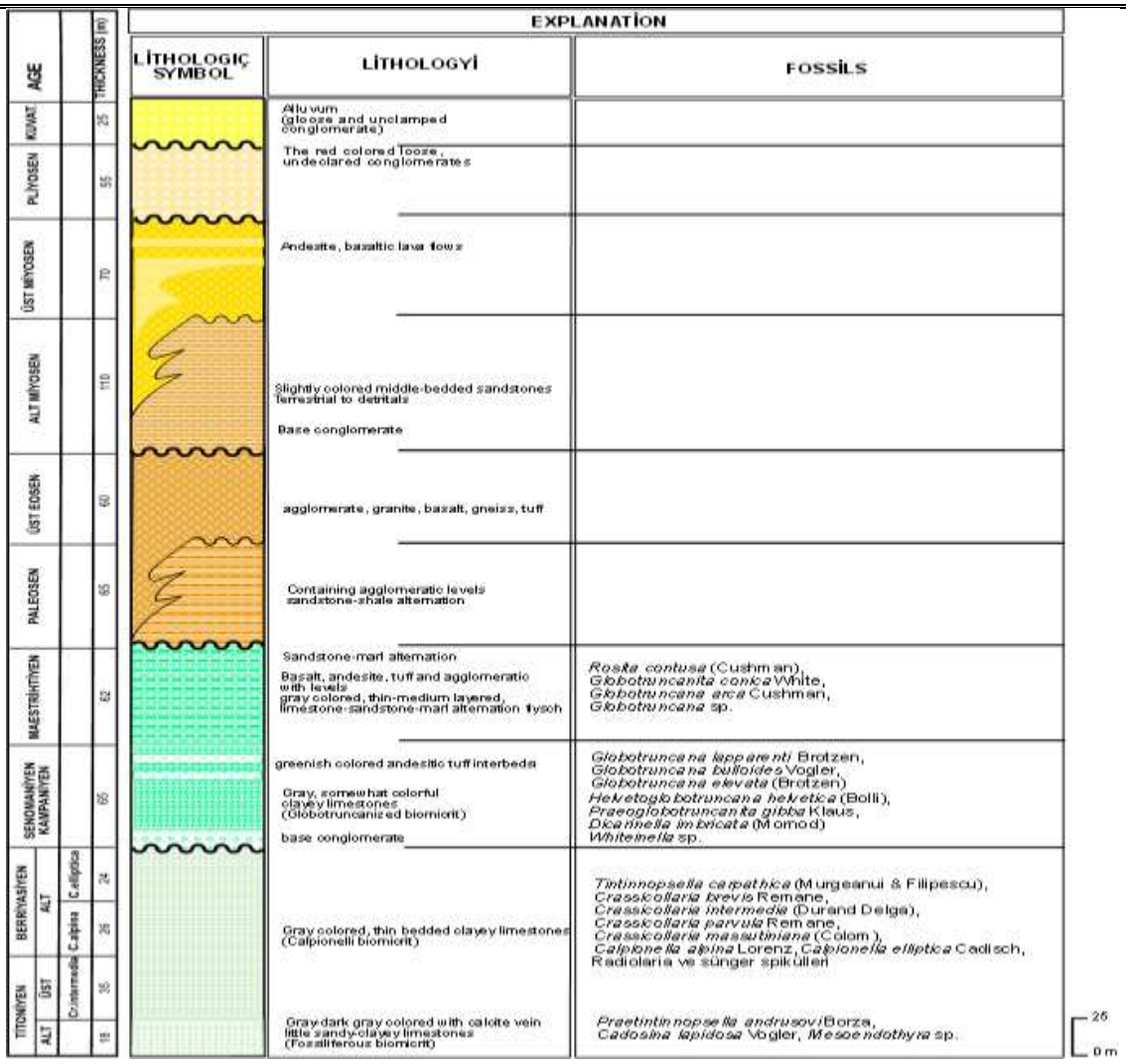

Figure 3. The generalized stratigraphic section of Gerede (Bolu) region

5. GEREDE TERRITORY MEASURED STRATIGRAPHY SECTIONS

5.1. Kazlar Measured Stratigraphy Cutting

This section taken north-southeast of the Gerede District in the study area on the Bolu G 28 Paftas from northwest to southeast leads to the KazlarDeresi between 45 20 950 latitude, 4 38 150 longitude start and 45 20 000 latitude 4 38 850 longitude finish coordinates It is 1300m in direction of SW. A total of 208m thickness was measured in this section and 38 samples were collected (Figure 4).

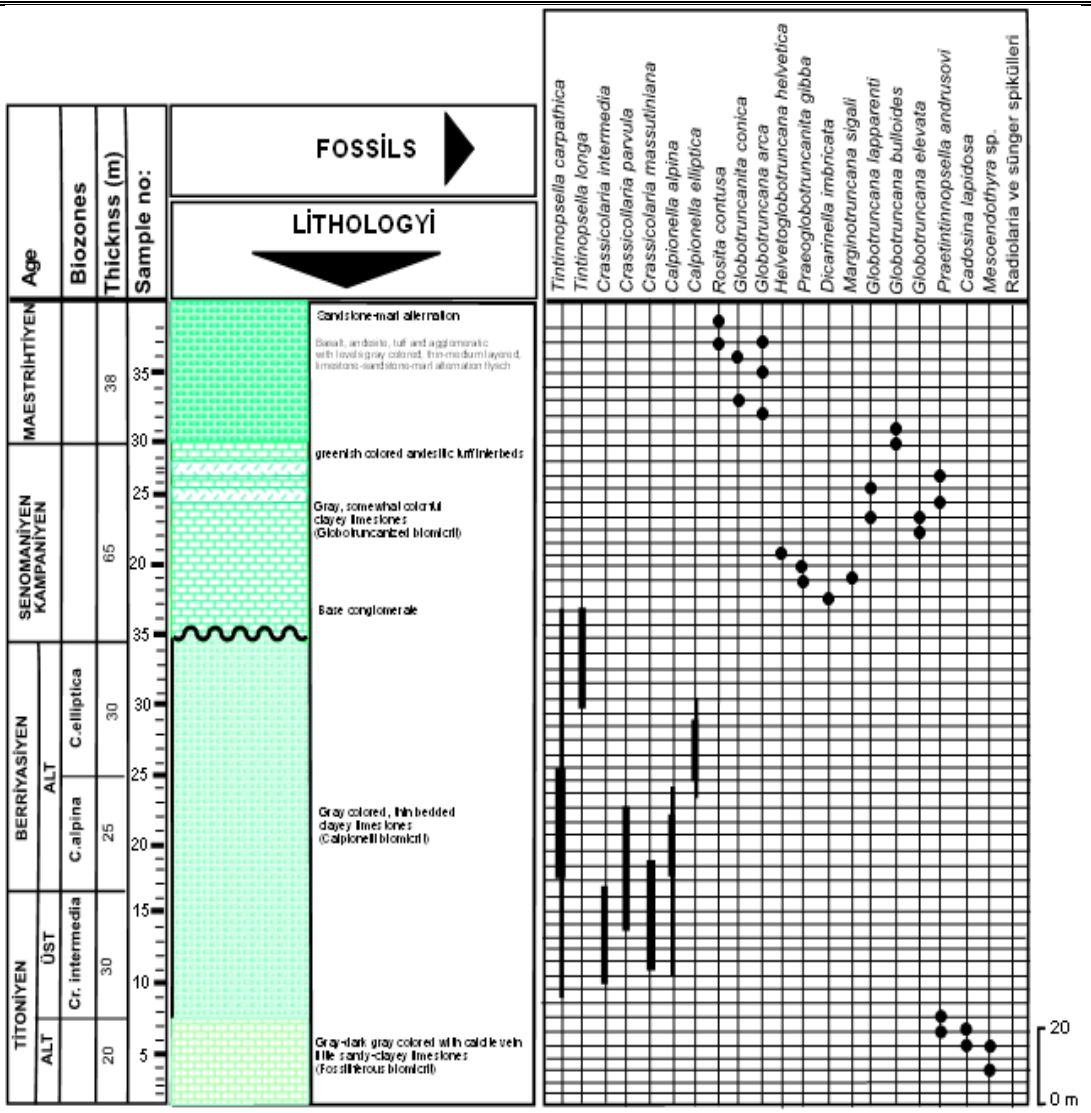

Figure 4. Kazlar measured stratigraphic section

5.2. Akdere Measured Stratigraphy Cutting

Beginning from Akdere located in the north of Gerede District in the study area located on the Bolu G 28 Paftas, this section is 800m long in the direction of the NW between 4 33 300 latitude, 45 26 000 long start and 4 32 600 latitude 45 26 400 longitude finish coordinates. A total of 199 m thickness was measured and 24 specimens were collected (Figure 5).

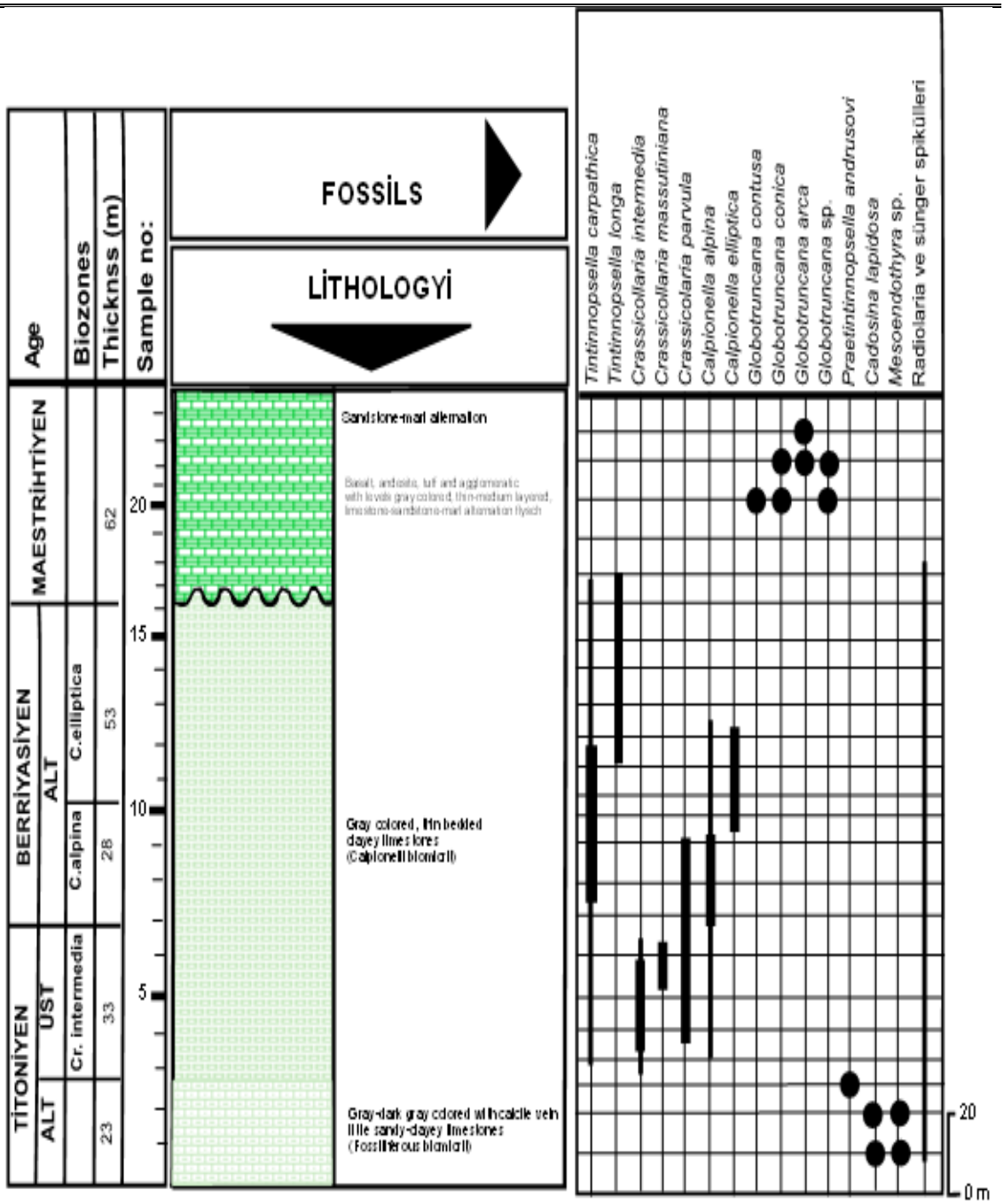

Figure 5. Akdere measured stratigraphic section

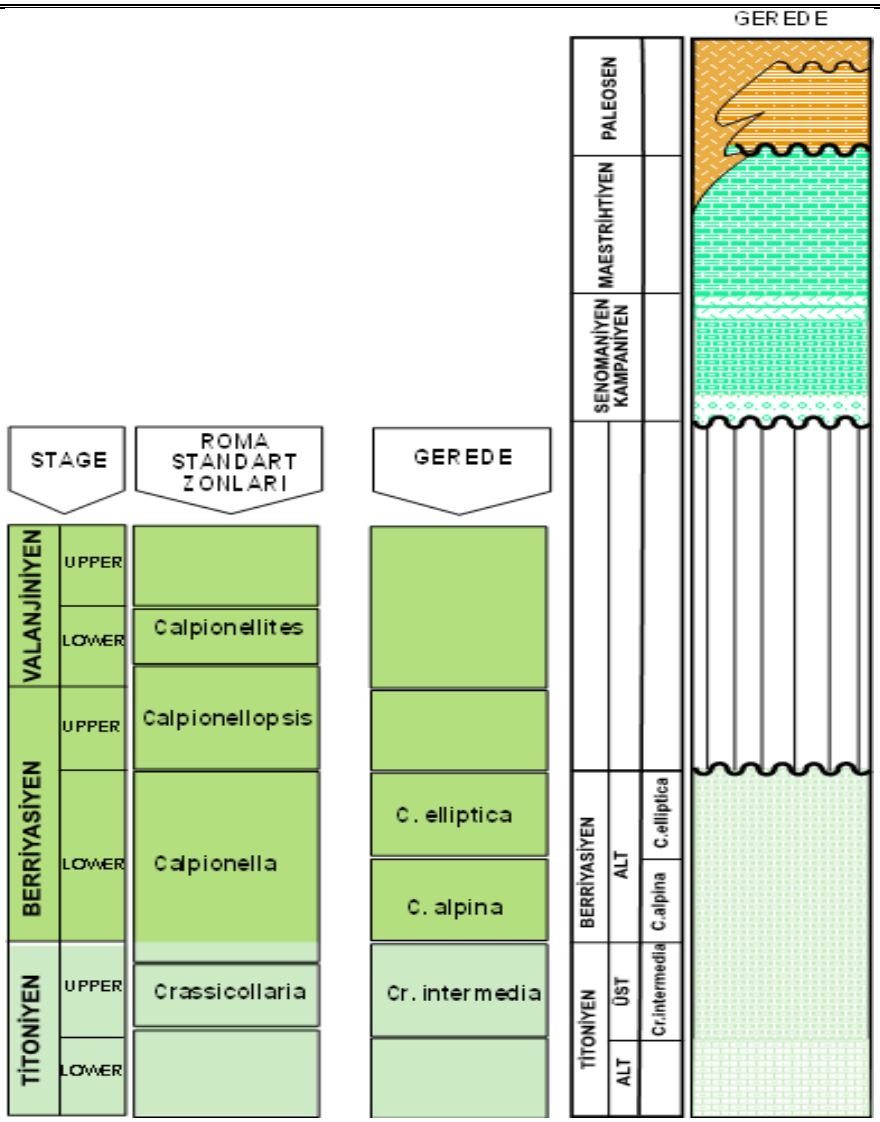

Figure 6. Detected biozones were compared to the Roman Standard Zone

6. CONCLUSIONS

In this study, The G28 a1 a2 a3 a4 topographical maps of 1/25.000 scale located to the north west of Turkey cover an area of 500km^2 in the Bolu province Gerede area which is within certain parts. Compared to the Roman Standard Zone. In this study, targeted geologic, stratigraphic, paleontological and biostratigraphic features of the Upper Mesozoic region were tried to be revealed. Detailed paleontological and biostratigraphic studies on rock samples obtained systematically from rocky sites with abundant titanic facies, including Calpionel, suggest that Tintinnopsella carpathica (Murgeanui & Filipescu), Crassicollaria brevis Remane, Crassicollaria intermedia (Durand Delga), Crassicollaria parvula Remane, Crassicollaria massutiniana (Colom), Calpionella alpina Lorenz, Calpionella elliptica Cadisch, total of 3 calpionel species and 7 species belonging to these species were identified and systematized. Biostratigraphic studies on late-Titonian-Early Valanjian aged, titanic facies-developed calpionelli and radiolarian biomicriticmicrobiophysical limestones revealed three calpionelbiozones, Crassicollaria intermedia, Calpionella alpina and Calpionella elliptica. Detected biozones were compared to the Roman

Standard Zone and the Crassicollaria intermedia-Calpionella zone boundary was observed to be inconsistent with the Roman Standard Zone boundary.

It is determined that the sequence of the Titonic facies in the region 6 is missing from the top. Upper Jurassic-Lower Cretaceous aged limestones, which are located in the Pontide basin, are mostly found to be rich in titonic facies and rich in calpionel content. Although the Upper Jurassic-Lower Cretaceous aged limestones that appear on the Pontide basin are usually composed of thin-bedded micritic limestones with the formation of titonic facies, it is observed that the entire does not include Calpionel. This is a sign that the calpions are locally provincial, although not real. Within the unit given to the Senomanian-Campanian age; Helvetoglobotruncana helvetica (Bolli), Praeoglobotruncana gibba Klaus, Dicarinella imbricata (Mor nod), Whiteinella sp. and Miliolidae fossils were found and in the uppermost levels of the unit, Globotruncaca bulloides Vogler, Globotruncana elevata (Brotzen), Globotruncana lapparenti Brotzen and Globotruncana sp planktonic foraminifera were detected. Within the Maestrihtian age units, Globotruncana arca Cushman, Globotruncanita conica White, Rosita contusa (Cushman) and Globotruncana sp. planktonic foraminifera were detected.

NOTICE

This study was presented as an oral presentation at the I. International Scientific and Vocational Studies Congress (BILMES 2017) in Nevşehir/Ürgüp between 5-8 October 2017.

REFERENCES

[1] Ajdukiewicz, Z., Mankiewicz, M. ve Pieniazek, J., (1946). Bolu Bitümlü Şistleri Hakkında Nihai Rapor. MTA Rapor No:1668.
[2] Baykal, F., (1954). Ulus-Eflani Arasındaki Mıntıka Hakkında Jeolojik Rapor: Maden Tetkik ve Arama Enstitüsü, Rapor, No:2125 (Yayımlanmamış).
[3] Blumenthal, M., (1937). Bolu Vilayeti Dahilindeki Gökdağ Mıntıkası Bitümlü Şist Sahasının Jeolojisi Hakkında Rapor. MTA No:269.
[4] Cerit, O., (1983). Mengen (Bolu) Yöresinin Jeolojik Incelemesi. Hacettepe üniversitesi Fen Bil. Ens. Yüksek Lisans Tezi (Yayınlanmamış), Ankara, 160s.
[5] Erdem, İ. ve Akalın, L., (1983). Mengen-Salıpazarı-Merkeşler Kömür Sahası Hakkında Rapor. MTA Rapor No:7421.
[6] Kaya, O., (1982). Ereğli, Yığılca, Bolu Kuzey, Mengen Alanlarının Stratigrafi ve Yapı Özellikleri: Türkiye Petrolleri A.O., Arama Grubu, Rapor No:1639 (Yayımlanmamış).
[7] Ketin, İ., (1967). Bolu, Gerede, Mengen ve Yığılca bölgesindeki Paleozoyik Teşekkülere Ait Jeolojik Rapor: Türkiye Petrolleri A. O., Arama Grubu, Rapor No:379 (Yayımlanmamış).
[8] Kipman, E., (1974). Sakarya, Çamdağ Alanının Jeolojisi: İstanbul Üniversitesi, Fen Fakültesi Doktora Tezi (yayımlanmamış).
[9] Lokman, K., (1939). Bolu (Mengen) Bitümlü Şistleri. MTA Rapor No:268.
[10] Saner, S., (1980). Mudurnu-Göynük Havzasının Jura ve Sonrası Çökelim Nitelikleriyle Paleocoğrafya Yorumlaması. TJK Bülteni, c.23, n.1 s:39-52.
[11] Sarı, A., (1999a). Source Rock Evaluation of Kabalar Formation in the Göynük Basin, Bolu, Turkey. 19th International Meeting on Organic Geochemistry. 6-10 September, İstanbul, Turkey. P:231-232.

[12] Sarı, A. ve Sonel, N., (1995). Kayabaşı (Göynük-Bolu) Yöresinin Bitümlü Şeyl İncelemeleri. Türkiye Jeoloji Büllteni. C:2, n:2, s:39-49.
[13] Sarı, A., (1999). Himmetoğlu Formasyonu (Göynük-Bolu) Bitümlü Şeyllerinin Organik Jeokimyasal İncelemesi. 1. Batı Anadolu Enerji Sempozyumu, 8-14 Mart, İzmir.
[14] Sarı, A., Üzmez, B. ve Aliyev, S.A., (2004). Mengen (Bolu) Civarı Bitümlü, Şeyllerinin Hidrokarbon Potansiyeli. İstanbul Üniv. Müh. Fak. Yerbilimleri Dergisi, c:17, n:3.
[15] Sonel, N., Sarı, A. ve Tozlu, E., (1987). Himmetoğlu (Göynük-Bolu)) Yöresinin Jeolojisi ve Linyit Oluşukları. Sakarya Üniversitesi, Müh. Mim. Fak. Dergisi, c:2, s:51-67.
[16] Sonel, N., Kayabalı, K., Sarı, A. ve Tozlu, E., (1987). Ahmetbeyler (Göynük-Bolu)) Yöresinin Jeolojisi ve Yapısal özellikleri. S.Ü. Müh. Mim. Fak. Dergisi. C:2, s:37-50.
[17] Uysalı, H., (1962). Kayaaltı-Salıpazarı-Mengen Bölgesi (Bolu) Kömür Sahasının Jeolojik Etüdü Hakkında Rapor. MTA rap.no:2931.
[18] Tekin, E., ve Sarı, A., (2000). Kabalar Formasyonu (Göynük-Bolu) Bitümlü Şeylerinde Ki Hidrokarbon Damlalarının Morfolojileri. Yerbilimleri/Geosound Dergisi, n:36, s:107-121.
[19] Tokay, M., (1952). Karadeniz Ereğlisi, Alaph, Kızıltepe, Alacaağzı Bölgesi Jeolojisi: Maden Tetkik ve Arama Enstitüsü Dergisi, sa., 4243, s:1-35.